

CLAIMS:

1. A low sidestream smoke emitting cigarette unit comprising:
 - i) a cigarette with conventional cigarette paper
5 surrounding a tobacco rod of said cigarette;
 - ii) a non combustible material for treating sidestream
smoke, surrounding and being substantially in contact with said conventional
cigarette paper of a tobacco rod portion of said cigarette; said material having
a porosity which encourages a conventional free-burn rate for said cigarette
10 within said material;
 - iii) said material comprising an oxygen storage component
which releases oxygen at free-burn rate temperatures adjacent a burning
coal of said cigarette whereby such released oxygen:
 - a) compensates for said material reducing rate
15 of oxygen diffusion to a burning coal to ensure said conventional free-burn
rate, and
 - b) contributes to the oxidation treatment of
components of sidestream smoke.
- 20 2. A cigarette unit of claim 1 wherein said oxygen storage component is a
metal oxide having multiple oxidation states.
3. A cigarette unit of claim 2 wherein said metal oxide is selected from the
group consisting of transition metal oxides, rare earth metal oxides and
25 lanthanide metal oxides.
4. A cigarette unit of claim 3 wherein said transition metal oxide is
selected from the group consisting of IVB, VB, VIB, VIIB, VIII and IB of the
Periodic Table of Elements, mixtures thereof and solid solutions of two or
30 more metal oxides.

5. A cigarette unit of claim 3 wherein said metal oxide is selected from oxides of the lanthanide metals.
6. A cigarette unit of claim 5 wherein said metal oxide is an oxide of cerium.
7. A cigarette unit of claim 1 wherein said material additionally comprises a catalyst for promoting oxidation of non-aqueous components, entering said material, said catalyst being in admixture with said oxygen storage component.
8. A cigarette unit of claim 7 wherein said catalyst is selected from the group consisting of platinum group of metals, transition metal oxides, rare earth metal oxides, lanthanide metal oxides, aluminum silicates, aluminum oxides and calcium carbonates and solid solutions of two or more metal oxides.
9. A cigarette unit of claim 8 wherein said catalyst is selected from the group consisting of aluminum silicates, platinum, palladium, iron, copper, silver and cerium.
10. A cigarette unit of claim 9 wherein said catalyst is an oxide of cerium or a solid solution of cerium with another metal oxide of claim 8.
11. A cigarette unit of claim 1 wherein said oxygen storage component has a dual function of an oxidation catalyst.
12. A cigarette unit of claim 11 wherein said dual function oxygen storage component and catalyst is selected from the group consisting of transition metal oxides having multiple oxidation states and lanthanide metal oxides.

13. A cigarette unit of claim 12 wherein said oxygen storage component and catalyst is an oxide of cerium.
14. A cigarette unit of claim 1 wherein said oxygen storage component is present in said material in an amount effective for said oxidation up to about 30% by weight.
15. A cigarette unit of claim 7 wherein said oxygen storage component and said catalyst are present in said material in a combined amount effective for said oxidation up to about 30% by weight.
16. A cigarette unit of claim 11 wherein said catalyst is present in said material in a amount effective for said oxidation up to about 30% by weight.
17. A cigarette unit of claim 14 wherein said oxygen storage component and/or catalyst are present in the range of about 5 to about 20% by weight.
18. A cigarette unit of claim 14 wherein oxygen storage material is additionally added to an interior surface of said material adjacent said cigarette paper.
19. A cigarette unit of claim 1 wherein said material has a porosity of at least about 200 Coresta units.
20. A cigarette unit of claim 19 wherein said material has a porosity of less than about 10,000 Coresta units.
21. A cigarette unit of claim 20 wherein said material has a porosity of about 300 up to about 4000 Coresta units.
22. A cigarette unit of claim 1 wherein said material is wrapped onto said cigarette paper to define a wrapper of material for said unit.

23. A cigarette unit of claim 1 wherein said material is preformed into a tube having an inner diameter which receives a cigarette and is in frictional engagement therewith.
- 5 24. A cigarette unit of claim 1 wherein said treatment material is applied to a cigarette by cigarette paper application equipment.
- 10 25. A cigarette unit of claim 1 wherein said treatment material additionally comprises a sorbent capable of sorbing components of sidestream smoke, said oxygen storage component contributing to oxidation treatment of sorbed components of sidestream smoke.
- 15 26. A cigarette unit of claim 25 wherein said sorbent is hydrophobic for selectively sorbing non-aqueous components of sidestream smoke.
- 20 27. A cigarette unit of claim 25 wherein said treatment material is capable of oxidizing non-sorbed gaseous components of sidestream smoke, which permeate said treatment material.
- 25 28. A cigarette unit of claim 25 wherein said sorbent material is selected from the group consisting of activated carbon, molecular sieves and porous metal oxides.
- 30 29. A cigarette unit of claim 28 wherein said sorbent is activated carbon.
- 30 30. A cigarette unit of claim 28 wherein said sorbent is a zeolite having pore diameters sufficient to sorb the non-aqueous components of sidestream smoke.
- 30 31. A cigarette unit of claim 30 wherein said zeolite has large pore sizing in the range of about 9 to 40Å.

32. A cigarette unit of claim 31 wherein said zeolite is a Y zeolite.
33. A cigarette unit of claim 30 wherein said zeolite sorbent has a dual function of sorbent and oxidation catalyst.
- 5 34. A cigarette unit of claim 28 wherein said porous metal oxide is prepared by heat treating a sheet material comprising metal oxides, sheet reinforcements and organics which are driven off during heat treatment to provide a porous sheet material.
- 10 35. A cigarette unit of claim 25 wherein said material is multilayered.
- 15 36. A cigarette unit of claim 35 wherein a first layer adjacent the cigarette paper is predominantly of said oxygen storage component, a second layer is predominantly said catalyst material or said sorbent material and a third layer is the other of said catalyst or sorbent.
- 20 37. A cigarette unit of claim 1 wherein said material as applied to said cigarette has a thickness in the range of about 0.04 mm to about 1 mm.
38. A cigarette unit of claim 1 wherein said material as applied to said cigarette has an outside surface which is unrestricted by any coating or additional paper wrap.
- 25 39. A cigarette unit comprising:
- i) a cigarette with cigarette paper surrounding a tobacco rod of said cigarette;
 - ii) a non combustible material surrounding and
- 30 in substantial contact with an outer periphery of said cigarette paper, said material having a porosity which encourages a free-burn rate, characteristic of said cigarette;

iii) said material comprising a substantially hydrophobic sorbent capable of sorbing non-aqueous components of the sidestream smoke emitted from a burning coal of said cigarette, and an oxygen storage component which releases oxygen at temperatures found adjacent a burning
5 coal of said cigarette whereby such released oxygen:

- a) compensates for said material reducing rate of oxygen diffusion to a burning coal to ensure its free-burn rate, and
- b) contributes to the oxidation treatment of components of sidestream smoke.

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40. A cigarette unit of claim 39 wherein said cigarette is capable of emitting low levels of sidestream smoke by virtue of said material surrounding said tobacco rod portion of said cigarette and treating sidestream smoke.

15 41. A cigarette unit of claim 39 wherein said cigarette paper has a non-conventional porosity which reduces free-burn rate.

42. A cigarette unit of claim 39 wherein said cigarette is a conventional cigarette having conventional cigarette paper and conventional
20 free-burn rate, said porosity of said material encouraging conventional free-burn for said cigarette.

43. A cigarette unit comprising a cigarette and a treatment material surrounding and substantially in contact with cigarette paper of said cigarette,
25 said treatment material having a porosity which encourages conventional free-burn rate of said cigarette and comprises an oxidation catalyst which facilitates oxidation treatment of sidestream smoke emitted from a burning coal of said cigarette, said cigarette paper decoupling said sidestream smoke treatment reaction from generation of mainstream smoke during cigarette
30 puff.

44. A cigarette unit of claim 43 wherein said catalyst is selected from the group consisting of platinum group of metals, transition metal oxides, rare earth metal oxides, lanthanide metal oxides, aluminum silicates, aluminum oxides and calcium carbonates.
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45. A cigarette unit of claim 44 wherein said catalyst is selected from the group consisting of aluminum silicates, platinum, palladium, iron, copper, silver and cerium.
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46. A cigarette unit of claim 45 wherein said catalyst is an oxide of cerium or a solid solution of cerium with another metal oxide.
47. A cigarette unit of claim 43 wherein said oxidation catalyst has a dual function as an oxygen storage component.
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48. A cigarette unit of claim 47 wherein said dual function oxygen storage component and catalyst is selected from the group consisting of transition metal oxides having multiple oxidation states and lanthanide metal oxides.
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49. A cigarette unit of claim 48 wherein said oxygen storage component and catalyst is an oxide of cerium.
50. A cigarette unit of claim 44 wherein said catalyst is present in said material in a amount effective for said oxidation up to about 30% by weight.
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51. A cigarette unit of claim 47 wherein said dual function catalyst is present in the range of about 5 to about 20% by weight.
52. A cigarette unit of claim 47 wherein dual function catalyst is additionally added to an interior surface of said material adjacent said cigarette paper.
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53. A cigarette unit of claim 43 wherein said material has a porosity of at least about 200 Coresta units.
54. A cigarette unit of claim 53 wherein said material has a porosity of less than about 10,000 Coresta units.
55. A cigarette unit of claim 54 wherein said material has a porosity of about 300 up to about 4000 Coresta units.
56. A cigarette unit of claim 43 wherein said cigarette is a conventional cigarette with conventional cigarette paper.
57. A method of treating sidestream smoke emitted by a burning cigarette having a sidestream smoke treatment material surrounding and substantially in contact with cigarette paper of a cigarette, said material having a porosity which encourages a conventional free-burn rate for said cigarette and comprising a sorbent and an oxygen storage component which releases oxygen at free-burn rate temperatures adjacent a burning coal of said cigarette, said method comprising:
- i) sorbing non-aqueous components of sidestream smoke emitted by burning said cigarette and holding said components;
 - ii) releasing treated volatiles which permeate said material and are invisible in atmosphere.
58. A method of claim 57 wherein said material comprises an oxidation catalyst for promoting oxidation of said adsorbed non-aqueous components, said catalyst facilitating oxidation of sorbed components to reduce total particulate matter of gases passing through said material.

59. A method of claim 57 wherein said oxygen storage component functions additionally as an oxidation catalyst, said combined oxygen storage component and catalyst treating components entering said material to reduce visible components of sidestream smoke to essentially zero.

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60. A method of claim 59 wherein said application of said material onto said cigarette paper decouples reactions for treating sidestream smoke components from mainstream smoke developed during puff, said decoupling of the treatment reactions from mainstream smoke production being achieved by:

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i) the porosity of said material permitting oxygen to diffuse through said material to encourage said cigarette's free-burn rate;

ii) locating said catalyst outside of said cigarette paper to locate treatment of said sidestream smoke components outside of said cigarette paper;

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iii) locating said sorbent outside of said cigarette paper to permit sidestream smoke components to leave freely said burning coal area in providing said free-burn rate where said sorbent adsorbs and desorbs sidestream smoke components outside of said cigarette paper to isolate sidestream component treatment from mainstream smoke generation;

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iv) said wrapper having a heat capacity which provides a cigarette periphery temperature and a cigarette centreline temperature essentially the same as the corresponding temperature locations of said cigarette burning without said material applied thereto.

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61. A method of claim 59 wherein said material is in sheet form and is wrapped onto said cigarette paper to provide a wrapper of a thickness in the range of about 0.04 mm to about 1 mm.

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62. A method of claim 59 wherein said material has a heat capacity which conducts heat away from a burning coal to provide a temperature at inside surface of said material adjacent a burning coal of said cigarette of about 400

to 550°C and a centreline temperature adjacent a burning coal of said cigarette of about 700 to about 950°C.

63. Sheet material for application to a cigarette to reduce sidestream smoke, said sheet material comprising a composition of substantially hydrophobic sorbent, sheet reinforcement and an oxygen storage component which releases oxygen at free-burn rate temperatures adjacent a burning coal of a cigarette, said sheet material having the characteristics of:
- i) a porosity in the range of at least about 200 Coresta units;
 - ii) a pore size of about 50Å to about 2 microns;
 - iii) a BET surface area for the composition greater than about 20 m²/g;
 - iv) a density of about 0.3 to about 0.8 g/cc; and
 - v) a sheet thickness of about 0.04 mm to about 1 mm.

64. Sheet material of claim 63 wherein said BET surface area is less than about 1000 m²/g.

65. Sheet material of claim 63 wherein said BET surface area is less than about 500m²/g.

66. Sheet material of claim 63 wherein said BET surface area is less than about 300m²/g.

67. Sheet material of claim 63 wherein said sorbent is activated carbon having a BET surface area of about 300 to about 1800 m²/g and a pore size distribution of about 9Å to about 40Å.

68. Sheet material of claim 63 wherein said sorbent is a zeolite having a BET surface area of about 300 to about 1000 m²/g and a pore size distribution of about 5Å to about 20Å.

69. Sheet material of claim 63 wherein said sorbent is a porous metal oxide having a BET surface area of about 10 to about 400 m²/g and a pore size distribution of about 5Å to about 20Å.
- 5 70. Sheet material of claim 63 wherein said material has a pore volume of about 0.05 to about 1.0 cm³/g.
71. Sheet material of claim 63 wherein said sheet reinforcement is in the form of strands, flakes or filament like materials.
- 10 72. Sheet material of claim 63 wherein said material has a pore openings in interstitial spaces ranging in size from about 200Å to about 2 microns.
73. Sheet material of claim 63 wherein said oxygen storage component is
15 a metal oxide having multiple oxidation states.
74. Sheet material of claim 73 wherein said metal oxide is selected from the group consisting of transition metal oxides, rare earth metal oxides and lanthanide metal oxides.
- 20 75. Sheet material of claim 73 wherein said transition metal oxide is selected from the group consisting of IVB, VB, VIB, VIIB, VIII and IB of the Periodic Table of Elements, mixtures thereof and solid solutions of two or more metal oxides.
- 25 76. Sheet material of claim 73 wherein said metal oxide is selected from oxides of the lanthanide metals.
- 30 77. Sheet material of claim 76 wherein said metal oxide is an oxide of cerium or a solid solution of cerium with another metal oxide.

78. Sheet material of claim 63 wherein said material additionally comprises a catalyst for promoting oxidation of said non-aqueous components.

5 79. Sheet material of claim 78 wherein said catalyst is selected from the group consisting of platinum group of metals, transition metal oxides, rare earth metal oxides, lanthanide metal oxides, aluminum silicates, aluminum oxides, calcium carbonates, mixtures thereof, and solid solutions of at least two of said metal oxides.

10 80. Sheet material of claim 79 wherein said catalyst is selected from the group consisting of zeolites, platinum, palladium and cerium.

81. Sheet material of claim 76 wherein said catalyst is an oxide of cerium.

15 82. Sheet material of claim 73 wherein said oxygen storage component has the dual function of an oxidation catalyst.

83. Sheet material of claim 82 wherein said oxygen storage component has a dual function as a catalyst selected from the group consisting of
20 transition metal oxides having multiple oxidation states and lanthanide metal oxides.

84. Sheet material of claim 83 wherein said dual function oxygen storage component and catalyst is an oxide of cerium.

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85. Sheet material of claim 63 wherein said oxygen storage component is present in said material in an amount effective for said oxidation up to about 30% by weight.

30 86. Sheet material of claim 78 wherein said oxygen storage component and said catalyst is present in said material in a combined amount effective for said oxidation up to about 30% by weight.

87. Sheet material of claim 82 wherein said dual function material is present in said material in a amount effective for said oxidation up to about 30% by weight.
- 5 88. Sheet material of claim 85 wherein said oxygen storage component and/or said catalyst is present in the amount of about 5% to about 20% by weight.
- 10 89. Sheet material of claim 85 wherein oxygen storage material is additionally added to an interior surface of said material adjacent said cigarette paper.
- 15 90. Sheet material of claim 63 wherein said material has a porosity of less than 10,000 Coresta units.
91. Sheet material of claim 90 wherein said material has a porosity of at least about 300 Coresta units.
- 20 92. Sheet material of claim 91 wherein said material has a porosity of less than 4000 Coresta units.
93. Sheet material of claim 63 wherein said material is wrapped onto said cigarette paper to define a wrapper of material for said unit.
- 25 94. Sheet material of claim 63 wherein said material is multilayered.
- 30 95. Sheet material of claim 94 wherein a first layer adjacent the cigarette paper is predominantly of said oxygen storage material, a second layer is predominantly said catalyst material or said sorbent material and a third layer is predominantly the other of catalyst or sorbent.

96. Sheet material of anyone of the preceding claims wherein said sorbent material is selected from the group consisting of activated carbon, molecular sieves and porous metal oxides.
- 5 97. Sheet material of claim 94 wherein said sorbent is activated carbon.
98. Sheet material of claim 94 wherein said sorbent is a zeolite having pore diameters sufficient to sorb non-aqueous components of sidestream smoke.
- 10 99. Sheet material of claim 96 wherein said zeolite is has large pore sizing in the range of about 9 to 40Å.
100. Sheet material of claim 97 wherein said zeolite is a Y zeolite.
- 15 101. Sheet material of claim 97 wherein said porous metal oxide is prepared by heat treating a sheet material comprising metal oxides, sheet reinforcements and organics which are driven off during heat treatment at temperatures in the range of about 300 to 800 degrees centigrade, to provide
- 20 a porous sheet material.
102. Sheet material of any one claim 63 wherein said material has a heat capacity which conducts heat away from a burning coal to provide a temperature at inside surface of said material adjacent a burning coal of said
- 25 cigarette of about 400 to 550 degrees centigrade and a centreline temperature adjacent a burning coal in said cigarette of about 700 to 950°C.
103. Sheet material of claim 63 wherein said sheet material as applied to said cigarette has a thickness in the range of about 0.04 mm to about 1mm.

104. Sheet material of claim 63 wherein said material as applied to said cigarette has an outside surface which is unrestricted by any coating or additional paper wrap.
- 5 105. A method of making a cigarette unit comprising wrapping a sheet material of claim 63 about a cigarette having cigarette paper.
106. A method of claim 105 wherein said wrapped sheet material is connected at a lap seam and glued in place, said wrapper being free of any
10 outer combustible covering.
107. A method of making a cigarette unit comprising wrapping a sheet material of claim 63 and simultaneously a cigarette paper onto a tobacco rod with said paper being innermost and adjacent said tobacco rod.
- 15 108. A method of claim 107 wherein said cigarette paper has a conventional porosity in the range of about 5 to about 70 Coresta units.
- 20 109. A method of making a cigarette unit comprising forming a tube of said material of claim 63 with a cigarette paper on an inside surface of said tube, said tube having an internal diameter sized to receive a non-smokeable cigarette tobacco rod which becomes smokeable when inserted into said tube.